WHAT IS CLAIMED IS:

5

     1.   An image processing device comprising:

     a character area extraction part extracting a character area from an original image that is a digital image;

10   a class classification part classifying pixels belonging to said character area into a first class and a second class according to colors;

     a black-character-color/ground-color estimation part estimating a black character color and a

15   ground color on said original image according to the pixels belonging to said character area being classified into said first class and said second class; and

     a tone correction part performing a tone correction to said original image according to the

20   estimated black character color and the estimated ground color.

25

2.   An image processing device comprising:

a character area extraction part extracting a

character area from an original image that is a digital

image;

5   a class classification part classifying pixels

belonging to said character area into a first class and

a second class according to colors;

a background color estimation part estimating

a background color on said original image according to

10   the pixels belonging to said character area being

classified into said first class and said second class;

a background area specification part

specifying a background area on said original image

according to the estimated background color; and

15   a tone correction part performing a tone

correction to said original image by replacing a color

of the specified background area with the estimated

background color.

20 .

3.   An image processing device comprising:

a character area extraction part extracting a

25 character area from an original image that is a digital

image;

a class classification part classifying pixels belonging to said character area into a first class and a second class according to colors;

5   a background color estimation part estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

a background area specification part

10   specifying a background area on said original image according to the estimated background color; and

a tone correction part performing a tone correction to said original image by replacing a color of the specified background area with a white color.

15

4.   An image processing device comprising:

20   a feature-value calculation part calculating a feature value with respect to an original image that is a digital image;

a character area extraction part extracting a character area from said original image according to

25   said feature value;

a block division part dividing said original image into blocks;

a class classification part classifying pixels belonging to said character area in each of said blocks
5   into a first class and a second class according to colors;

a black-character-color/ground-color estimation part estimating a black character color and a ground color on said original image according to the
10 pixels belonging to said character area being classified into said first class and said second class; and

a tone correction part performing a tone correction to said original image according to the estimated black character color and the estimated ground
15 color.

20   5.   An image processing device comprising:

a feature-value calculation part calculating a feature value with respect to an original image that is a digital image;

a character area extraction part extracting a
25 character area from said original image according to

said feature value;

a block division part dividing said original image into blocks;

a class classification part classifying pixels
5   belonging to said character area in each of said blocks into a first class and a second class according to colors;

a background color estimation part estimating a background color on said original image according to
10 the pixels belonging to said character area being classified into said first class and said second class;

a background area specification part specifying a background area on said original image according to the estimated background color; and
15 a tone correction part performing a tone correction to said original image by replacing a color of the specified background area with the estimated background color.

20

6. An image processing device comprising:

a feature-value calculation part calculating a
25 feature value with respect to an original image that is

a digital image;

a character area extraction part extracting a character area from said original image according to said feature value;

5   a block division part dividing said original image into blocks;

a class classification part classifying pixels belonging to said character area in each of said blocks into a first class and a second class according to

10   colors;

a background color estimation part estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

15   a background area specification part specifying a background area on said original image according to the estimated background color; and

a tone correction part performing a tone correction to said original image by replacing a color

20   of the specified background area with a white color.

25   7. The image processing device as claimed in

claim 4, wherein said feature-value calculation part calculates an average value and a standard deviation of color signals in a window set around each pixel, and

said character area extraction part extracts a

5 pixel and pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

10

8. The image processing device as claimed in claim 5, wherein said feature-value calculation part

15 calculates an average value and a standard deviation of color signals in a window set around each pixel, and

said character area extraction part extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in

20 relation to a threshold value based on said average value and said standard deviation.

25

9.   The image processing device as claimed in claim 6, wherein said feature-value calculation part calculates an average value and a standard deviation of color signals in a window set around each pixel, and

5   said character area extraction part extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

10

10.   The image processing device as claimed in

15   claim 4, wherein said feature-value calculation part calculates an edge amount of each pixel, and

said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said

20   pixel, as said character area.

25   11.   The image processing device as claimed in

claim 5, wherein said feature-value calculation part

calculates an edge amount of each pixel, and

said character area extraction part extracts a

pixel having the edge amount equal to or larger than a

5   predetermined threshold value, and pixels around said

pixel, as said character area.

10

12.   The image processing device as claimed in

claim 6, wherein said feature-value calculation part

calculates an edge amount of each pixel, and

said character area extraction part extracts a

15   pixel having the edge amount equal to or larger than a

predetermined threshold value, and pixels around said

pixel, as said character area.

20

13.   The image processing device as claimed in

claim 4, wherein said feature-value calculation part

calculates an edge amount of each pixel and calculates

25   an average value and a standard deviation of color

signals in a window set around each pixel, and

said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said

5   pixel, as said character area, and extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

10

14.   The image processing device as claimed in

15   claim 5, wherein said feature-value calculation part calculates an edge amount of each pixel and calculates an average value and a standard deviation of color signals in a window set around each pixel, and

said character area extraction part extracts a

20   pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, as said character area, and extracts a pixel and pixels around said pixel as said character area according to a color signal value of said pixel in

25   relation to a threshold value based on said average

value and said standard deviation.

5

15. The image processing device as claimed in claim 6, wherein said feature-value calculation part calculates an edge amount of each pixel and calculates an average value and a standard deviation of color

10 signals in a window set around each pixel, and

said character area extraction part extracts a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, as said character area, and extracts a pixel and

15 pixels around said pixel as said character area according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

20

16. The image processing device as claimed in claim 4, wherein said class classification part obtains

25 a brightness threshold value based on a brightness

calculated from color signals of each of the pixels, and

classifies a group of pixels each having the brightness

lower than said brightness threshold value into said

first class, and a group of pixels each having the

5   brightness higher than said brightness threshold value

into said second class.

10

17.   The image processing device as claimed in

claim 5, wherein said class classification part obtains

a brightness threshold value based on a brightness

calculated from color signals of each of the pixels, and

15   classifies a group of pixels each having the brightness

lower than said brightness threshold value into said

first class, and a group of pixels each having the

brightness higher than said brightness threshold value

into said second class.

20

18.   The image processing device as claimed in

25   claim 6, wherein said class classification part obtains

a brightness threshold value based on a brightness
calculated from color signals of each of the pixels, and
classifies a group of pixels each having the brightness
lower than said brightness threshold value into said

5   first class, and a group of pixels each having the
brightness higher than said brightness threshold value
into said second class.

10

19.   The image processing device as claimed in
claim 4, wherein said black-character-color/ground-color
estimation part estimates an average color of a group of

15   pixels classified into said first class in one of said
blocks including a maximum number of pixels classified
into said second class as the black character color, and
estimates an average color of a group of said pixels
classified into said second class as the ground color,

20   according to a result of said classifying by said class
classification part in each of said blocks.

25

20. The image processing device as claimed in claim 5, wherein said background color estimation part estimates an average color of a group of pixels classified into said second class in one of said blocks

5 including a maximum number of said pixels classified into said second class as the background color, according to a result of said classifying by said class classification part in each of said blocks.

10

21. The image processing device as claimed in claim 6, wherein said background color estimation part

15 estimates an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class as the background color, according to a result of said classifying by said class

20 classification part in each of said blocks.

25 22. The image processing device as claimed in

claim 4, wherein said black-character-color/ground-color

estimation part estimates an average color of a group of

pixels classified into said first class in one of said

blocks including said group of said pixels classified

5   into said first class and a group of pixels classified

into said second class, the groups having a maximum

difference in average brightness therebetween, as the

black character color, and estimates an average color of

said group of said pixels classified into said second

10   class as the ground color, according to a result of said

classifying by said class classification part in each of

said blocks.

15

     23.   The image processing device as claimed in

claim 5, wherein said background color estimation part

estimates an average color of a group of pixels

20   classified into said second class in one of said blocks

including a group of pixels classified into said first

class and said group of said pixels classified into said

second class, the groups having a maximum difference in

average brightness therebetween, as the background color,

25   according to a result of said classifying by said class

classification part in each of said blocks.

5

24. The image processing device as claimed in claim 6, wherein said background color estimation part estimates an average color of a group of pixels classified into said second class in one of said blocks

10 including a group of pixels classified into said first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, as the background color, according to a result of said classifying by said class

15 classification part in each of said blocks.

20 25. The image processing device as claimed in claim 16, wherein said tone correction part performs the tone correction according to a tone conversion curve based on an average value and a standard deviation of brightness in a group of pixels classified into said

25 first class in one of said blocks including a maximum

number of pixels classified into said second class, and on an average value and a standard deviation of brightness in a group of said pixels classified into said second class, according to a result of said

5   classifying by said class classification part in each of said blocks.

10

26.   The image processing device as claimed in claim 16, wherein said tone correction part performs the tone correction according to a tone conversion curve based on an average value and a standard deviation of

15   brightness in a group of pixels classified into said first class in one of said blocks including said group of said pixels classified into said first class and a group of pixels classified into said second class, the groups having a maximum difference in average brightness

20   therebetween, and on an average value and a standard deviation of brightness in said group of said pixels classified into said second class, according to a result of said classifying by said class classification part in each of said blocks.

25

27. The image processing device as claimed in claim 4, further comprising a low-resolution image generation part generating a low-resolution image having a lower resolution than said original image,

5   wherein said feature-value calculation part calculates the feature value from said low-resolution image, and

said character area extraction part extracts said character area from said low-resolution image.

10

28. The image processing device as claimed in

15 claim 5, further comprising a low-resolution image generation part generating a low-resolution image having a lower resolution than said original image,

wherein said feature-value calculation part calculates the feature value from said low-resolution

20 image, and

said character area extraction part extracts said character area from said low-resolution image.

25

29. The image processing device as claimed in claim 6, further comprising a low-resolution image generation part generating a low-resolution image having a lower resolution than said original image,

5   wherein said feature-value calculation part calculates the feature value from said low-resolution image, and

        said character area extraction part extracts said character area from said low-resolution image.

10

30. An image processing program interpreted

15 by a computer so as to cause said computer to perform:

        a character area extraction function of extracting a character area from an original image that is a digital image;

        a class classification function of classifying

20 pixels belonging to said character area into a first class and a second class according to colors;

        a black-character-color/ground-color estimation function of estimating a black character color and a ground color on said original image

25 according to the pixels belonging to said character area

being classified into said first class and said second class; and

a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground color.

10

31.   An image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

a background area specification function of specifying a background area on said original image

according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a color of the specified background area with the

5   estimated background color.

10   32.   An image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of extracting a character area from an original image that is a digital image;

15   a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

a background color estimation function of estimating a background color on said original image

20   according to the pixels belonging to said character area being classified into said first class and said second class;

a background area specification function of specifying a background area on said original image

25   according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a color of the specified background area with a white color.

5

33. An image processing program interpreted

10 by a computer so as to cause said computer to perform:

a feature-value calculation function of calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of

15 extracting a character area from said original image according to said feature value;

a block division function of dividing said original image into blocks;

a class classification function of classifying

20 pixels belonging to said character area in each of said blocks into a first class and a second class according to colors;

a black-character-color/ground-color estimation function of estimating a black character

25 color and a ground color on said original image

according to the pixels belonging to said character area being classified into said first class and said second class; and

a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground color.

34. An image processing program interpreted by a computer so as to cause said computer to perform:

a feature-value calculation function of calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of extracting a character area from said original image according to said feature value;

a block division function of dividing said original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according to colors;

a background color estimation function of
estimating a background color on said original image
according to the pixels belonging to said character area
being classified into said first class and said second

5   class;

a background area specification function of
specifying a background area on said original image
according to the estimated background color; and

a tone correction function of performing a

10 tone correction to said original image by replacing a
color of the specified background area with the
estimated background color.

15

35.   An image processing program interpreted
by a computer so as to cause said computer to perform:

a feature-value calculation function of

20 calculating a feature value with respect to an original
image that is a digital image;

a character area extraction function of
extracting a character area from said original image
according to said feature value;

25   a block division function of dividing said

original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according

5   to colors;

a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second

10   class;

a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a

15   tone correction to said original image by replacing a color of the specified background area with a white color.

20

36. The image processing program as claimed in claim 33, wherein an average value and a standard deviation of color signals in a window set around each

25   pixel are calculated by said feature-value calculation

function, and

a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of

5   said pixel in relation to a threshold value based on said average value and said standard deviation.

10

37.   The image processing program as claimed in claim 34, wherein an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation

15 function, and

a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on

20 said average value and said standard deviation.

25   38.   The image processing program as claimed

in claim 35, wherein an average value and a standard
deviation of color signals in a window set around each
pixel are calculated by said feature-value calculation
function, and

5   a pixel and pixels around said pixel are
extracted as said character area by said character area
extraction function according to a color signal value of
said pixel in relation to a threshold value based on
said average value and said standard deviation.

10

39.   The image processing program as claimed
15 in claim 33, wherein an edge amount of each pixel is
calculated by said feature-value calculation function,
and

a pixel having the edge amount equal to or
larger than a predetermined threshold value, and pixels
20 around said pixel, are extracted as said character area
by said character area extraction function.

25

40. The image processing program as claimed in claim 34, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

5   a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function.

10

41. The image processing program as claimed in claim 35, wherein an edge amount of each pixel is

15 calculated by said feature-value calculation function, and

          a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area

20 by said character area extraction function.

25   42. The image processing program as claimed

in claim 33, wherein an edge amount of each pixel, and an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

5   a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function, and a pixel and pixels around said pixel are extracted as said

10   character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

15

     43.   The image processing program as claimed in claim 34, wherein an edge amount of each pixel, and

20   an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and
          a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels

25   around said pixel, are extracted as said character area

by said character area extraction function, and a pixel
and pixels around said pixel are extracted as said
character area by said character area extraction
function according to a color signal value of said pixel

5   in relation to a threshold value based on said average
value and said standard deviation.

10

44. The image processing program as claimed
in claim 35, wherein an edge amount of each pixel, and
an average value and a standard deviation of color
signals in a window set around each pixel are calculated

15   by said feature-value calculation function, and
a pixel having the edge amount equal to or
larger than a predetermined threshold value, and pixels
around said pixel, are extracted as said character area
by said character area extraction function, and a pixel

20   and pixels around said pixel are extracted as said
character area by said character area extraction
function according to a color signal value of said pixel
in relation to a threshold value based on said average
value and said standard deviation.

25

45. The image processing program as claimed in claim 33, wherein a brightness threshold value is obtained according to a brightness calculated from color signals of each of the pixels by said class

5 classification function, and a group of pixels each having the brightness lower than said brightness threshold value are classified into said first class, and a group of pixels each having the brightness higher than said brightness threshold value are classified into

10 said second class by said class classification function.

15   46. The image processing program as claimed in claim 34, wherein a brightness threshold value is obtained according to a brightness calculated from color signals of each of the pixels by said class classification function, and a group of pixels each

20 having the brightness lower than said brightness threshold value are classified into said first class, and a group of pixels each having the brightness higher than said brightness threshold value are classified into said second class by said class classification function.

25

47. The image processing program as claimed
in claim 35, wherein a brightness threshold value is
obtained according to a brightness calculated from color
signals of each of the pixels by said class

5 classification function, and a group of pixels each
having the brightness lower than said brightness
threshold value are classified into said first class,
and a group of pixels each having the brightness higher
than said brightness threshold value are classified into

10 said second class by said class classification function.

15 48. The image processing program as claimed
in claim 33, wherein an average color of a group of
pixels classified into said first class in one of said
blocks including a maximum number of pixels classified
into said second class is estimated as the black

20 character color by said black-character-color/ground-
color estimation function, and an average color of a
group of said pixels classified into said second class
is estimated as the ground color by said black-
character-color/ground-color estimation function,

25 according to a result of said classifying by said class

classification function in each of said blocks.

5

49. The image processing program as claimed in claim 34, wherein an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class is estimated as the background color by said background color estimation function, according to a result of said classifying by said class classification function in each of said blocks.

15

50. The image processing program as claimed in claim 35, wherein an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class is estimated as the background color by said background color estimation function, according to a result of said classifying by

said class classification function in each of said

blocks.

5

51.   The image processing program as claimed

in claim 33, wherein an average color of a group of

pixels classified into said first class in one of said

10 blocks including said group of said pixels classified

into said first class and a group of pixels classified

into said second class, the groups having a maximum

difference in average brightness therebetween, is

estimated as the black character color by said black-

15 character-color/ground-color estimation function, and an

average color of said group of said pixels classified

into said second class is estimated as the ground color

by said black-character-color/ground-color estimation

function, according to a result of said classifying by

20 said class classification function in each of said

blocks.

25

52. The image processing program as claimed in claim 34, wherein an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said

5 first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the background color by said background color estimation function, according to a result of said

10 classifying by said class classification function in each of said blocks.

15

53. The image processing program as claimed in claim 35, wherein an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said

20 first class and said group of said pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the background color by said background color estimation function, according to a result of said

25 classifying by said class classification function in

each of said blocks.

5

54. The image processing program as claimed
in claim 45, wherein the tone correction is performed by
said tone correction function according to a tone
conversion curve based on an average value and a
10 standard deviation of brightness in a group of pixels
classified into said first class in one of said blocks
including a maximum number of pixels classified into
said second class, and on an average value and a
standard deviation of brightness in a group of said
15 pixels classified into said second class, according to a
result of said classifying by said class classification
function in each of said blocks.

20

55. The image processing program as claimed
in claim 45, wherein the tone correction is performed by
said tone correction function according to a tone
25 conversion curve based on an average value and a

standard deviation of brightness in a group of pixels

classified into said first class in one of said blocks

including said group of said pixels classified into said

first class and a group of pixels classified into said

5   second class, the groups having a maximum difference in

average brightness therebetween, and on an average value

and a standard deviation of brightness in said group of

said pixels classified into said second class, according

to a result of said classifying by said class

10   classification function in each of said blocks.

15   56.   The image processing program as claimed

in claim 33, further causing said computer to perform a

low-resolution image generation function of generating a

low-resolution image having a lower resolution than said

original image,

20   wherein the feature value is calculated from

said low-resolution image by said feature-value

calculation function, and

          said character area is extracted from said

low-resolution image by said character area extraction

25   function.

57. The image processing program as claimed in claim 34, further causing said computer to perform a low-resolution image generation function of generating a low-resolution image having a lower resolution than said

5   original image,

wherein the feature value is calculated from said low-resolution image by said feature-value calculation function, and

said character area is extracted from said

10   low-resolution image by said character area extraction function.

15

58. The image processing program as claimed in claim 35, further causing said computer to perform a low-resolution image generation function of generating a low-resolution image having a lower resolution than said

20   original image,

wherein the feature value is calculated from said low-resolution image by said feature-value calculation function, and

said character area is extracted from said

25   low-resolution image by said character area extraction

function.

5

     59. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

     a character area extraction function of

10 extracting a character area from an original image that is a digital image;

     a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

15   a black-character-color/ground-color estimation function of estimating a black character color and a ground color on said original image according to the pixels belonging to said character area being classified into said first class and said second

20 class; and

     a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground color.

25

60. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of
5 extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

10 a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

15 a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a
20 color of the specified background area with the estimated background color.

25

61. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a character area extraction function of
5   extracting a character area from an original image that is a digital image;

a class classification function of classifying pixels belonging to said character area into a first class and a second class according to colors;

10   a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second class;

15   a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a tone correction to said original image by replacing a
20   color of the specified background area with a white color.

25

62. A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a feature-value calculation function of

5 calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of extracting a character area from said original image according to said feature value;

10 a block division function of dividing said original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according

15 to colors;

a black-character-color/ground-color estimation function of estimating a black character color and a ground color on said original image according to the pixels belonging to said character area

20 being classified into said first class and said second class; and

a tone correction function of performing a tone correction to said original image according to the estimated black character color and the estimated ground

25 color.

63.   A computer readable recording medium storing an image processing program interpreted by a computer so as to cause said computer to perform:

a feature-value calculation function of

5   calculating a feature value with respect to an original image that is a digital image;

a character area extraction function of extracting a character area from said original image according to said feature value;

10   a block division function of dividing said original image into blocks;

a class classification function of classifying pixels belonging to said character area in each of said blocks into a first class and a second class according

15   to colors;

a background color estimation function of estimating a background color on said original image according to the pixels belonging to said character area being classified into said first class and said second

20   class;

a background area specification function of specifying a background area on said original image according to the estimated background color; and

a tone correction function of performing a

25   tone correction to said original image by replacing a

color of the specified background area with the
estimated background color.

5

64. A computer readable recording medium
storing an image processing program interpreted by a
computer so as to cause said computer to perform:

10 a feature-value calculation function of
calculating a feature value with respect to an original
image that is a digital image;

a character area extraction function of
extracting a character area from said original image

15 according to said feature value;

a block division function of dividing said
original image into blocks;

a class classification function of classifying
pixels belonging to said character area in each of said

20 blocks into a first class and a second class according
to colors;

a background color estimation function of
estimating a background color on said original image
according to the pixels belonging to said character area

25 being classified into said first class and said second

class;

a background area specification function of specifying a background area on said original image according to the estimated background color; and

5   a tone correction function of performing a tone correction to said original image by replacing a color of the specified background area with a white color.

10

65. The computer readable recording medium as claimed in claim 62, wherein an average value and a

15   standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

a pixel and pixels around said pixel are extracted as said character area by said character area

20   extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

25

66. The computer readable recording medium as claimed in claim 63, wherein an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value
5   calculation function, and

a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on
10   said average value and said standard deviation.

15   67. The computer readable recording medium as claimed in claim 64, wherein an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function, and

20   a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

25

68. The computer readable recording medium as claimed in claim 62, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

5   a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function.

10

69. The computer readable recording medium as claimed in claim 63, wherein an edge amount of each
15 pixel is calculated by said feature-value calculation function, and

        a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area
20 by said character area extraction function.

25   70. The computer readable recording medium as

claimed in claim 64, wherein an edge amount of each pixel is calculated by said feature-value calculation function, and

a pixel having the edge amount equal to or

5   larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function.

10

71.   The computer readable recording medium as claimed in claim 62, wherein an edge amount of each pixel, and an average value and a standard deviation of

15   color signals in a window set around each pixel are calculated by said feature-value calculation function, and

a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels

20   around said pixel, are extracted as said character area by said character area extraction function, and a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel

25   in relation to a threshold value based on said average

value and said standard deviation.

5

72. The computer readable recording medium as claimed in claim 63, wherein an edge amount of each pixel, and an average value and a standard deviation of color signals in a window set around each pixel are
10 calculated by said feature-value calculation function, and

a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area
15 by said character area extraction function, and a pixel and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average
20 value and said standard deviation.

25 73. The computer readable recording medium as

claimed in claim 64, wherein an edge amount of each pixel, and an average value and a standard deviation of color signals in a window set around each pixel are calculated by said feature-value calculation function,

5   and

a pixel having the edge amount equal to or larger than a predetermined threshold value, and pixels around said pixel, are extracted as said character area by said character area extraction function, and a pixel

10   and pixels around said pixel are extracted as said character area by said character area extraction function according to a color signal value of said pixel in relation to a threshold value based on said average value and said standard deviation.

15

74.   The computer readable recording medium as

20   claimed in claim 62, wherein a brightness threshold value is obtained according to a brightness calculated from color signals of each of the pixels by said class classification function, and a group of pixels each having the brightness lower than said brightness

25   threshold value are classified into said first class,

and a group of pixels each having the brightness higher
than said brightness threshold value are classified into
said second class by said class classification function.

5

75. The computer readable recording medium as
claimed in claim 63, wherein a brightness threshold

10 value is obtained according to a brightness calculated
from color signals of each of the pixels by said class
classification function, and a group of pixels each
having the brightness lower than said brightness
threshold value are classified into said first class,

15 and a group of pixels each having the brightness higher
than said brightness threshold value are classified into
said second class by said class classification function.

20

76. The computer readable recording medium as
claimed in claim 64, wherein a brightness threshold
value is obtained according to a brightness calculated

25 from color signals of each of the pixels by said class

classification function, and a group of pixels each
having the brightness lower than said brightness
threshold value are classified into said first class,
and a group of pixels each having the brightness higher
5   than said brightness threshold value are classified into
said second class by said class classification function.

10

         77.   The computer readable recording medium as
claimed in claim 62, wherein an average color of a group
of pixels classified into said first class in one of
said blocks including a maximum number of pixels
15   classified into said second class is estimated as the
black character color by said black-character-
color/ground-color estimation function, and an average
color of a group of said pixels classified into said
second class is estimated as the ground color by said
20   black-character-color/ground-color estimation function,
according to a result of said classifying by said class
classification function in each of said blocks.

25

78. The computer readable recording medium as claimed in claim 63, wherein an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels

5 classified into said second class is estimated as the background color by said background color estimation function, according to a result of said classifying by said class classification function in each of said blocks.

10

79. The computer readable recording medium as

15 claimed in claim 64, wherein an average color of a group of pixels classified into said second class in one of said blocks including a maximum number of said pixels classified into said second class is estimated as the background color by said background color estimation

20 function, according to a result of said classifying by said class classification function in each of said blocks.

25

80. The computer readable recording medium as claimed in claim 62, wherein an average color of a group of pixels classified into said first class in one of said blocks including said group of said pixels

5   classified into said first class and a group of pixels classified into said second class, the groups having a maximum difference in average brightness therebetween, is estimated as the black character color by said black-character-color/ground-color estimation function, and an

10   average color of said group of said pixels classified into said second class is estimated as the ground color by said black-character-color/ground-color estimation function, according to a result of said classifying by said class classification function in each of said

15   blocks.

20   81. The computer readable recording medium as claimed in claim 63, wherein an average color of a group of pixels classified into said second class in one of said blocks including a group of pixels classified into said first class and said group of said pixels

25   classified into said second class, the groups having a

maximum difference in average brightness therebetween,

is estimated as the background color by said background

color estimation function, according to a result of said

classifying by said class classification function in

5   each of said blocks.

10   82.   The computer readable recording medium as

claimed in claim 64, wherein an average color of a group

of pixels classified into said second class in one of

said blocks including a group of pixels classified into

said first class and said group of said pixels

15   classified into said second class, the groups having a

maximum difference in average brightness therebetween,

is estimated as the background color by said background

color estimation function, according to a result of said

classifying by said class classification function in

20   each of said blocks.

25   83.   The computer readable recording medium as

claimed in claim 74, wherein the tone correction is
performed by said tone correction function according to
a tone conversion curve based on an average value and a
standard deviation of brightness in a group of pixels
5   classified into said first class in one of said blocks
including a maximum number of pixels classified into
said second class, and on an average value and a
standard deviation of brightness in a group of said
pixels classified into said second class, according to a
10   result of said classifying by said class classification
function in each of said blocks.

15

        84.   The computer readable recording medium as
claimed in claim 74, wherein the tone correction is
performed by said tone correction function according to
a tone conversion curve based on an average value and a
20   standard deviation of brightness in a group of pixels
classified into said first class in one of said blocks
including said group of said pixels classified into said
first class and a group of pixels classified into said
second class, the groups having a maximum difference in
25   average brightness therebetween, and on an average value

and a standard deviation of brightness in said group of
said pixels classified into said second class, according
to a result of said classifying by said class
classification function in each of said blocks.

5

85.   The computer readable recording medium as

10   claimed in claim 62, wherein the image processing
program further causes said computer to perform a low-
resolution image generation function of generating a
low-resolution image having a lower resolution than said
original image,

15   wherein the feature value is calculated from
said low-resolution image by said feature-value
calculation function, and
said character area is extracted from said
low-resolution image by said character area extraction

20   function.

25   86.   The computer readable recording medium as

claimed in claim 63, wherein the image processing
program further causes said computer to perform a low-
resolution image generation function of generating a
low-resolution image having a lower resolution than said
5   original image,

wherein the feature value is calculated from
said low-resolution image by said feature-value
calculation function, and

said character area is extracted from said
10   low-resolution image by said character area extraction
function.

15

87.   The computer readable recording medium as
claimed in claim 64, wherein the image processing
program further causes said computer to perform a low-
resolution image generation function of generating a
20   low-resolution image having a lower resolution than said
original image,

wherein the feature value is calculated from
said low-resolution image by said feature-value
calculation function, and
25   said character area is extracted from said

low-resolution image by said character area extraction
function.